DiJet Angular Distribution

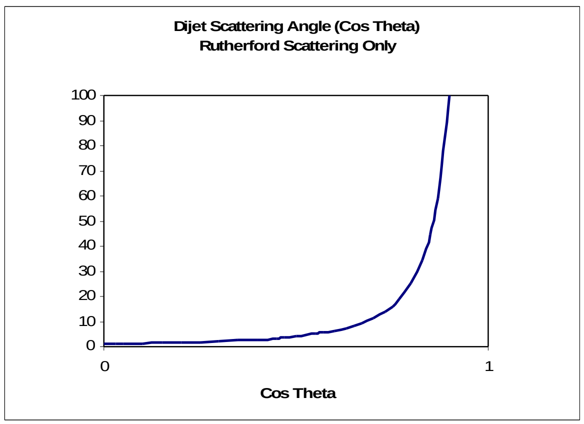
- What I'm trying to measure
- How well can I measure this?
  - Generator level distributions
  - MC detector level distributions
  - resolutions from MC
- What the data look like
  - samples and cuts

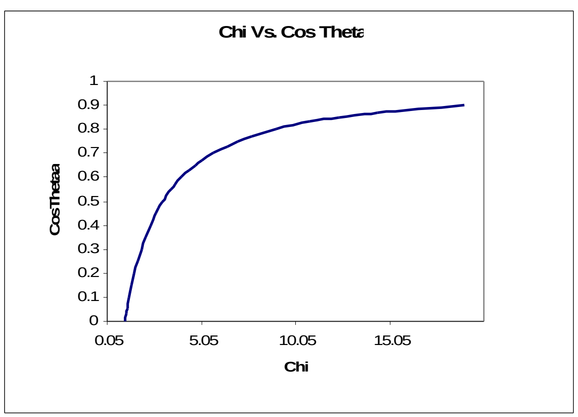
QCD DiJets

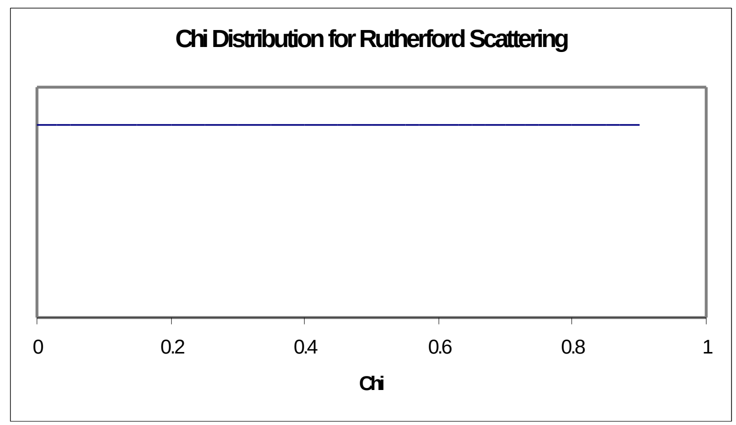
- **Variable definitions**
  - **We want to look at dijet angular distributions**
  - **To compare with theory, define the following varibles**
- **Leading dijet c variable**
  - $c = e^{|\eta_1 - \eta_2|} = (1+\cos q^*)/(1-\cos q^*)$, **where** q^* **is the angle between the two jets in the c.m.**

QCD DiJets

- **Variable definitions**
  - **For Rutherford scattering, this looks like:**



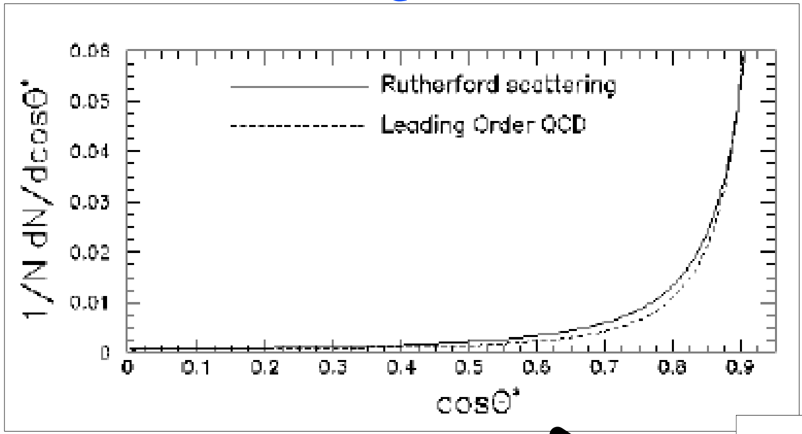




1/N dN/dX = constant
for pure Rutherford Scattering

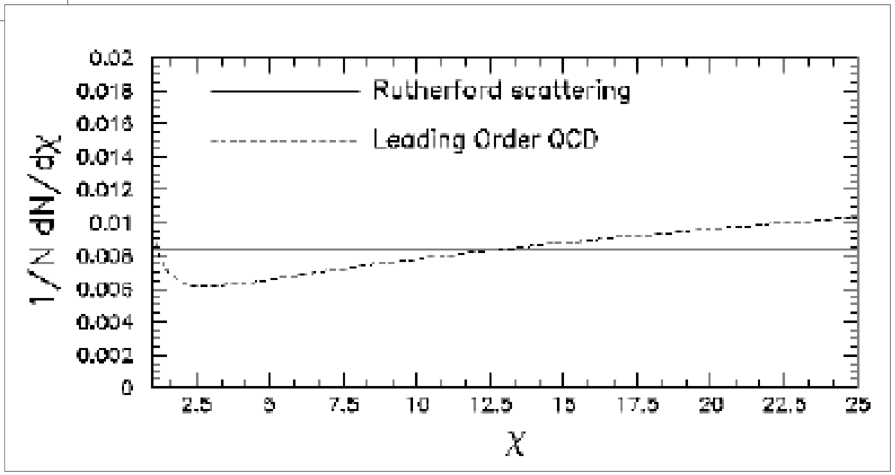
QCD DiJets

- **Variable definitions**
  - **For LO QCD this looks like**



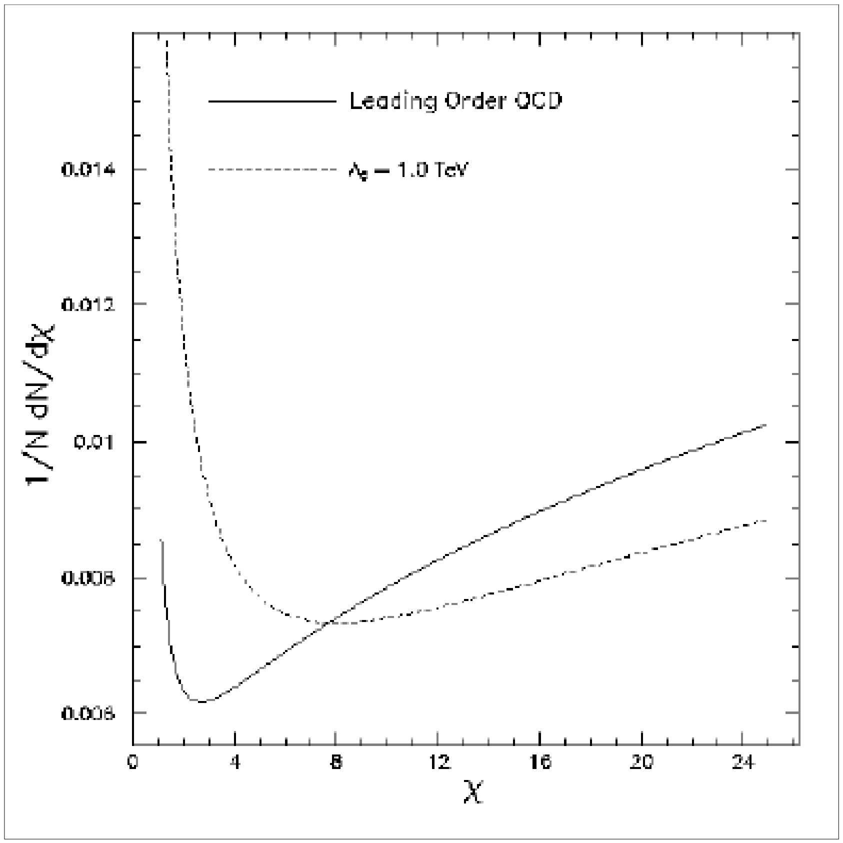
Hard to discern between pure Rutherford and NLO QCD in cos(q*)

Clear distinction in c distribution between Rutherford and NLO



QCD DiJets

- **What about compositeness?**



Effect of compositeness scale on c

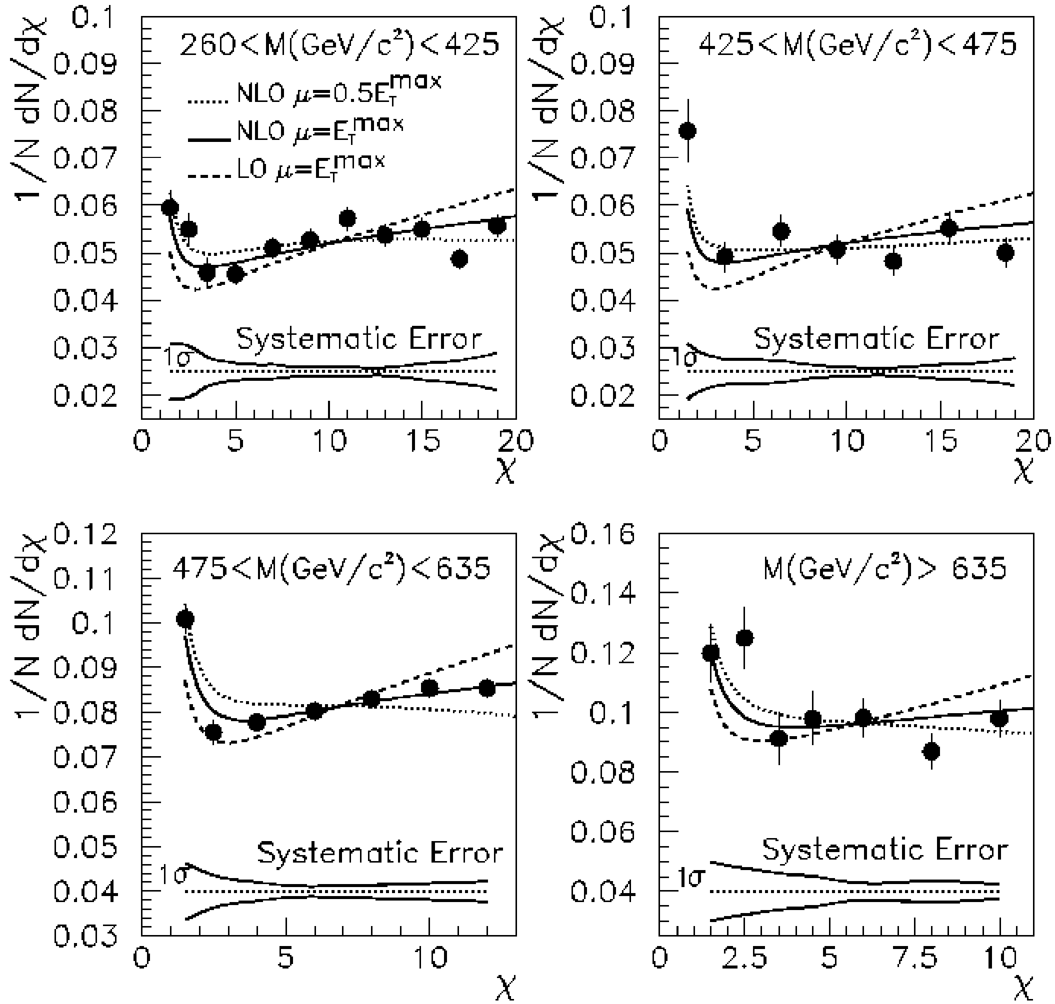
QCD DiJets

Results from Run I

PRL 80 666 (98)

Systematic Error:

•Largest systematic uncertainty from eta dependence of calorimeter energy scale (~2% level)



QCD DiJets

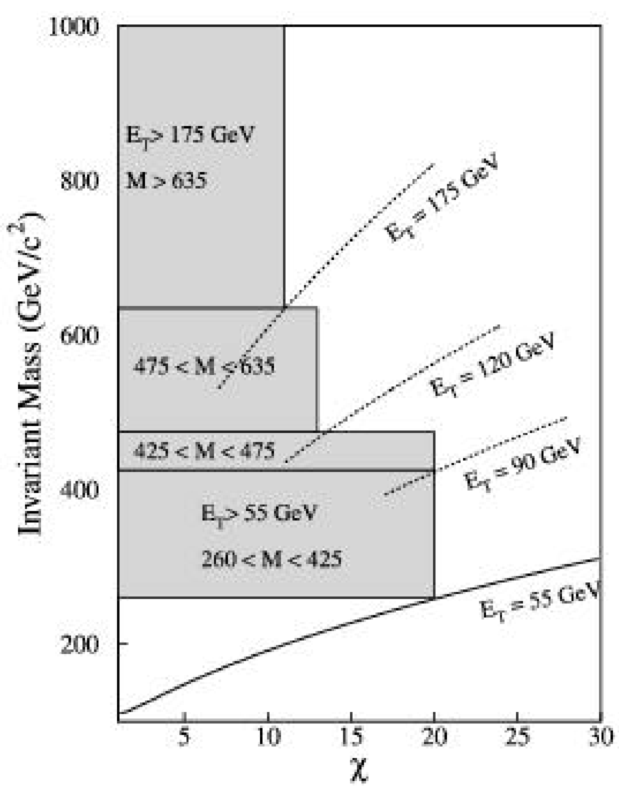
- **Acceptance Bins for Run II**
  - **E_T requirement on leading jet (trigger requirement)**
  - **Calculate maximum c with ~100% acceptance (phase space) from:**

$$M^2 = 2E^2_T \, [\cosh(\ln(c))+1]$$

Choose mass bins of ~ constant phase space acceptance

QCD DiJets

- **Acceptance Bins for Run II**



Define the following bins

Trigger	ET	Mass Range	c Max
JT25TT_NG	80.0	285-470	20.
JT45TT	95.0	470-545	20.
JT65TT	130.0	545-690	15.
JT95TT	190.0	>690	11.

Monte Carlo Results

- **Used Alexander's Pythia generation**

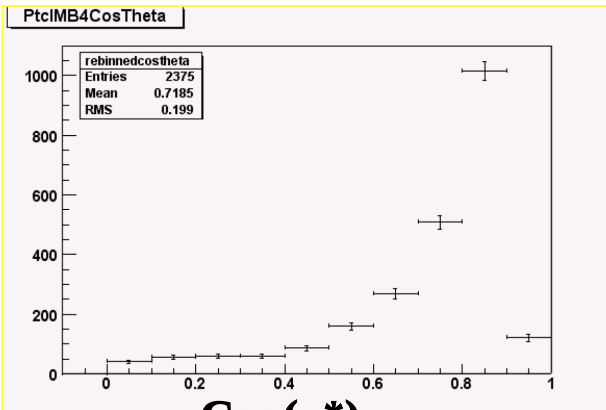
Define the following bins

Trigger	E_T	Mass Range	c Max	MonteCarlo
JT25TT_NG	80.0	285-470	20.	QCD20,QCD40
JT45TT	95.0	470-545	20.	QCD40,QCD20
JT65TT	130.0	545-690	13.	QCD80
JT95TT	190.0	>690	11.	QCD160

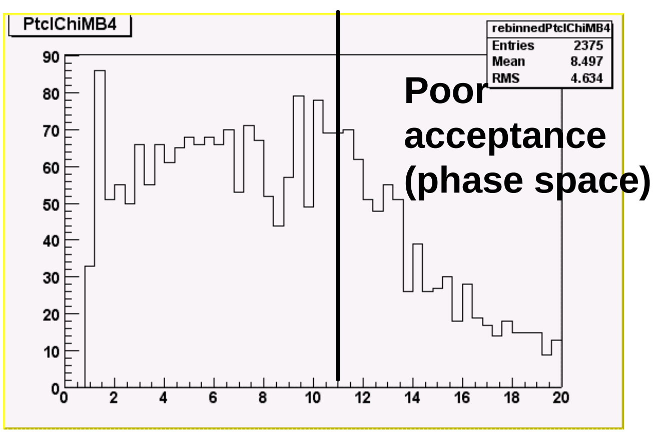
I am looking only at the highest mass bin for now

Generator Level (JCMG)

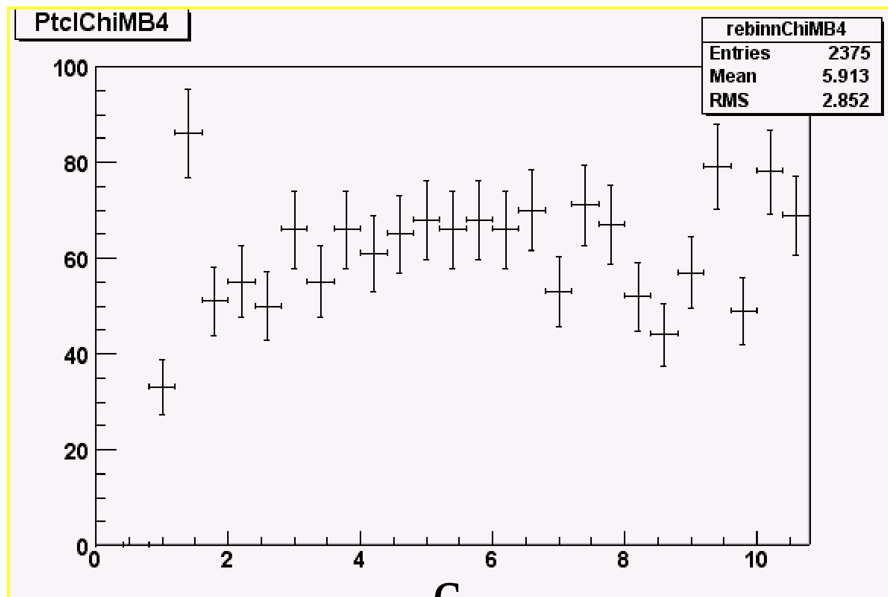
QCD160, dijet mass > 655 GeV/c²



Cos(q*)



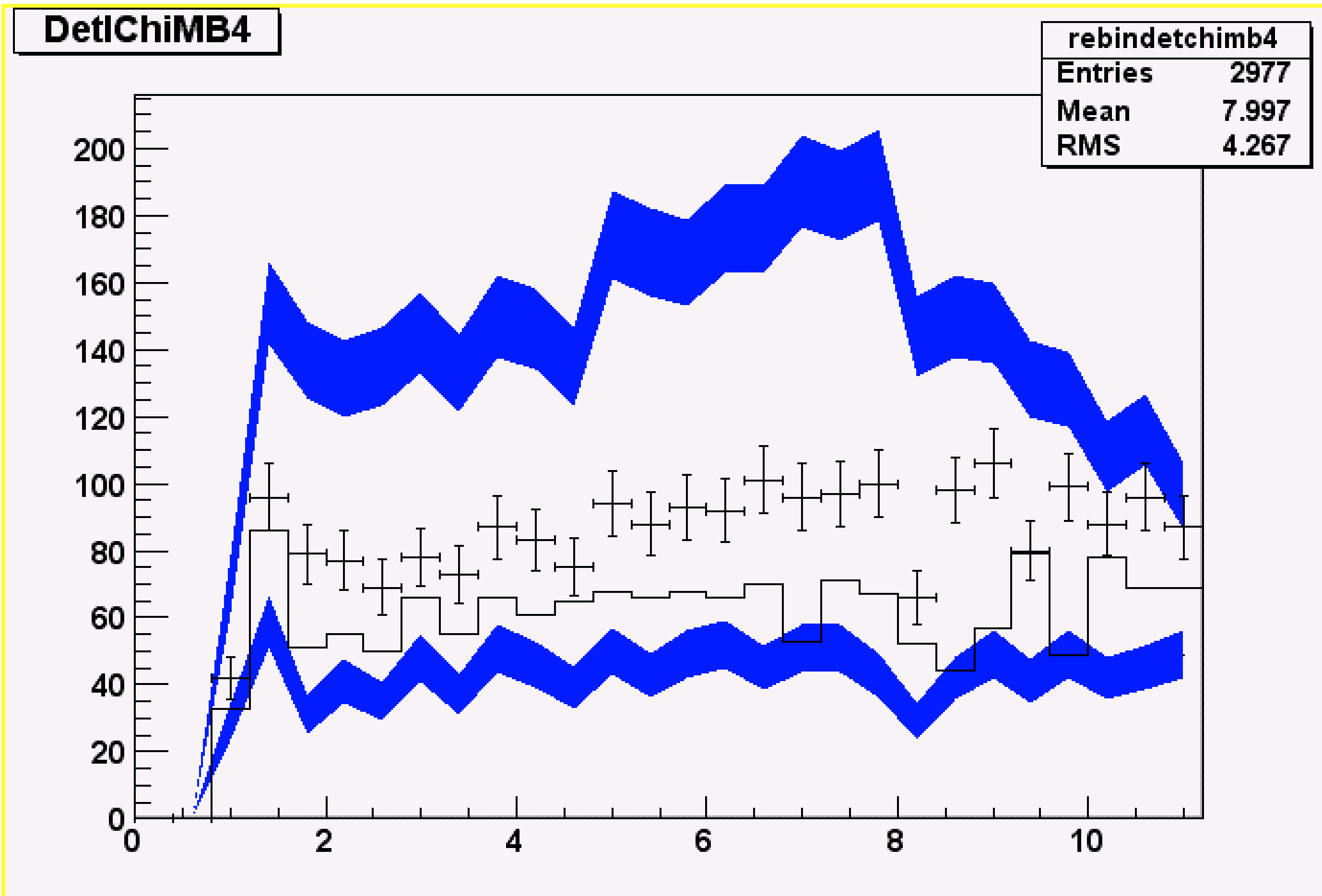
C



C

Monte Carlo, Detector Level

QCD160, dijet mass > 655 GeV/c^2

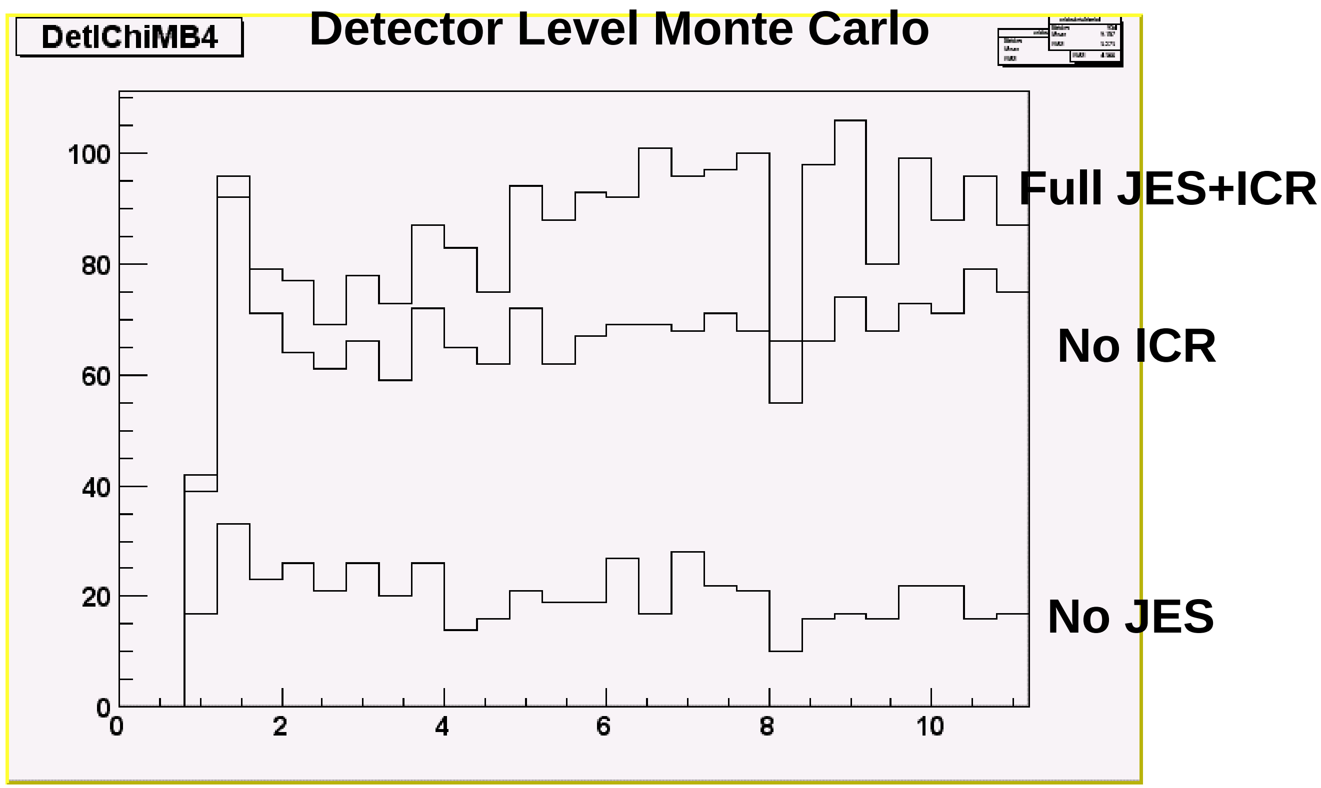


Monte Carlo, JES effects

QCD160, dijet mass > 655 GeV/c^2
with and without JES, with all JES except ICR correction

For compositeness analysis, it is the shape that is important, not the normalization

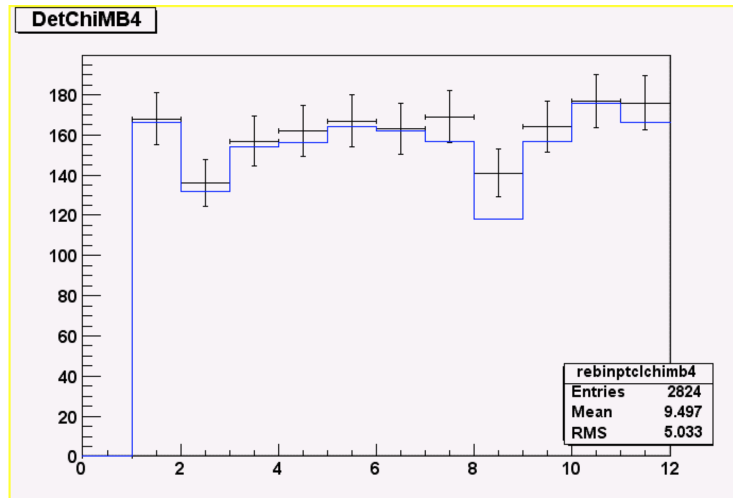
shape is heavily dependent on ICR correction



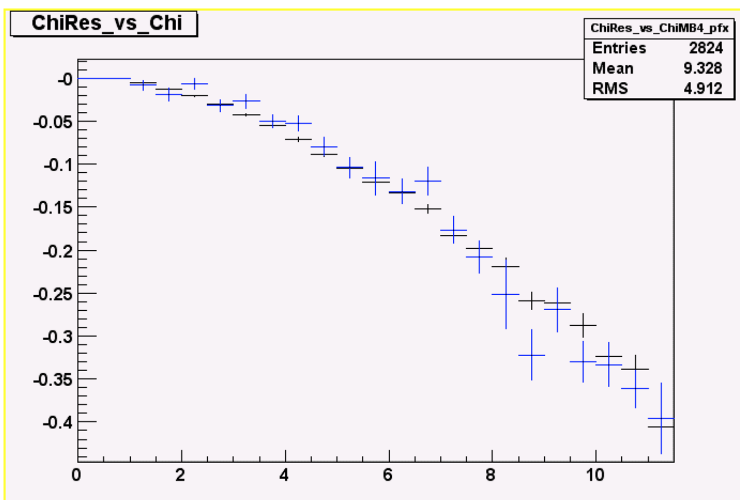
Monte Carlo resolutions using “matched” jets

QCD

Looked at dijet events where we match the generated jet with the “detector”level jet.



Blue histogram = ptcl level
black points = detector level



c for M_{JJ} > 655 GeV and for “all” M_{JJ} using QCD160 Pythia generation

(detector level - ptcl level c for matched jets)

Data Sample and Cuts

- Data Sample
  - **Using Pavel's root tuples**
  - **Divided data sample into groups:**
    - p13.05
      - Run_number < 174845 (L1 Cal $|\eta| < 2.4$)
        - **(~2.2M events)**
    - p13.06
      - Run_number < 174845 (L1 Cal $|\eta| < 2.4$)
        - **(~2.6M events)**
      - Run_number >= 174845 (L1 Cal $|\eta| <3.2$)
        - **(~2.5M events)**

Data Sample and Cuts

- **Data Sample**
  - **Used latest bad run lists (v3.2/2.1) from Jet/Met**
  - **Used corrected energy turn ons for trigger thresholds**
  - **moved cuts +- 10% around to see how they affect the data**

Trigger	Nominal Threshold
JT_25TT_NG	80 GeV
JT_45TT	90 GeV
JT_65TT	130 GeV
JT_95TT	190 GeV

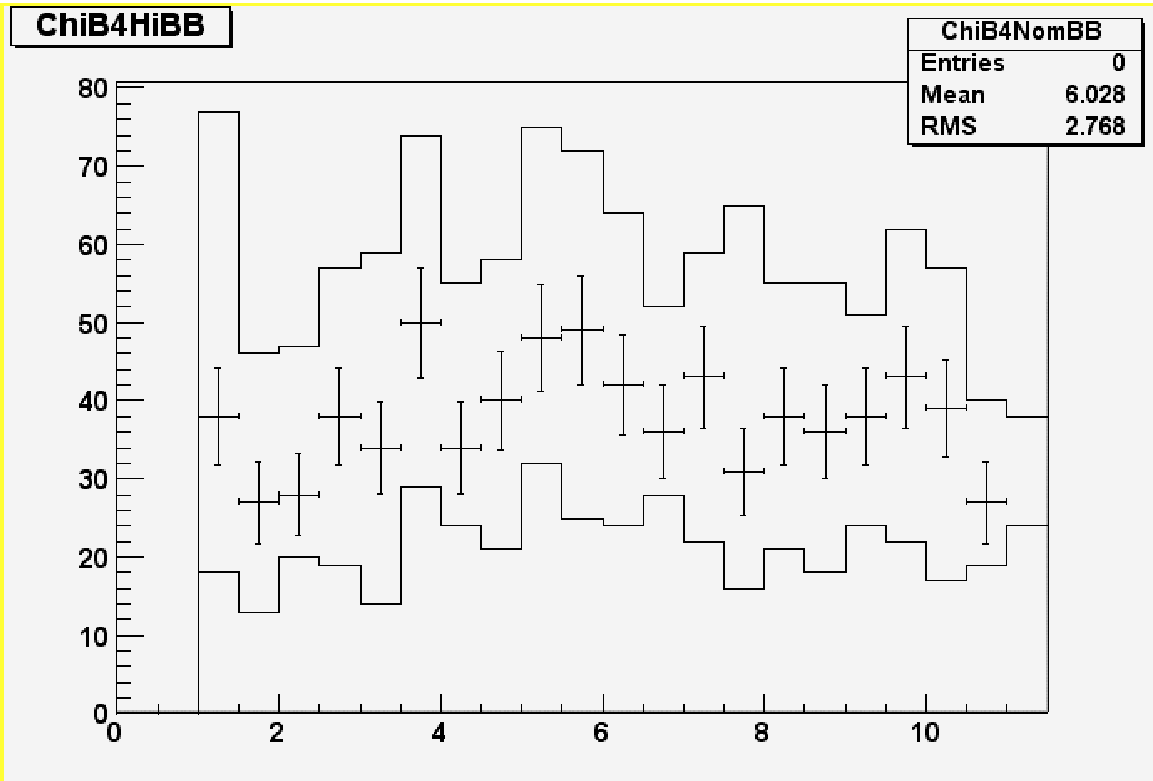
QCD

Data Sample and Cuts

- **Data Cuts**
  - **Event Cuts**
    - MET < 0.7 * (P_T of leading jet)
    - Vertex must have at least 5 tracks, |zvertex| < 50.0 cm
    - There must be at least two jets
    - Two highest E_T jets must pass jet quality cuts
    - leading jet must satisfy trigger threshold in $|\eta|$ < 2.4 or 3.2
      - **note MC only has pt generation in |h| < 2.4,**
  - **Jet Cuts**
    - HotFraction (highest ET cell)/(2nd highest cell) < 10
    - 0.05 < EMfrac < 0.95
    - CHfrac < 0.4
    - Jet N90 (# cells containing 90% of the jet energy) > 1
    - (CHF < 0.15) or (f90 < 0.5) (New July cut)

QCD DiJets

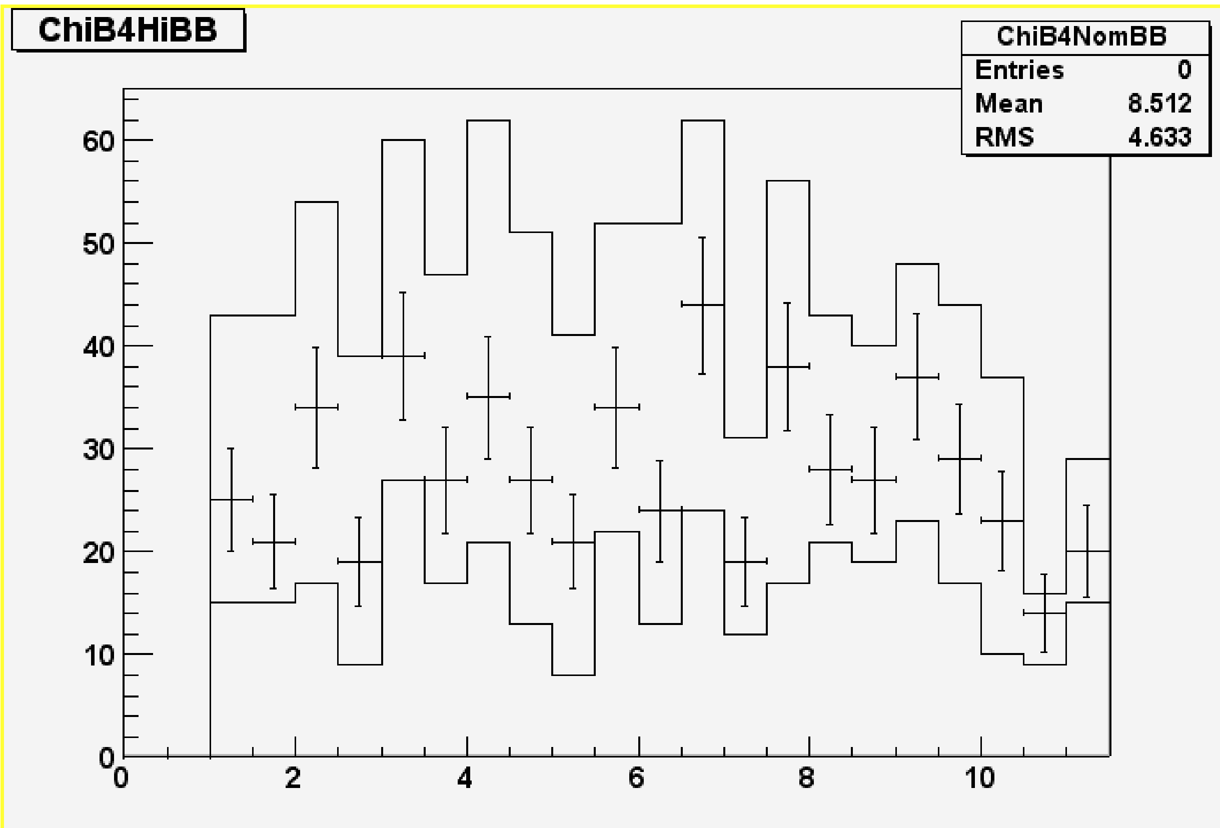
- **Results for Highest Mass bin (dijet mass > 690 GeV) for JT_95_TT trigger**



- **Data sample:**
  - **p13.06**
  - **Cal L1 |h| < 3.2**
- **No Acceptance Correction**
- **JES uncertainties**
  - **Redid analysis**
    1 sigma high
    1 sigma low

QCD DiJets

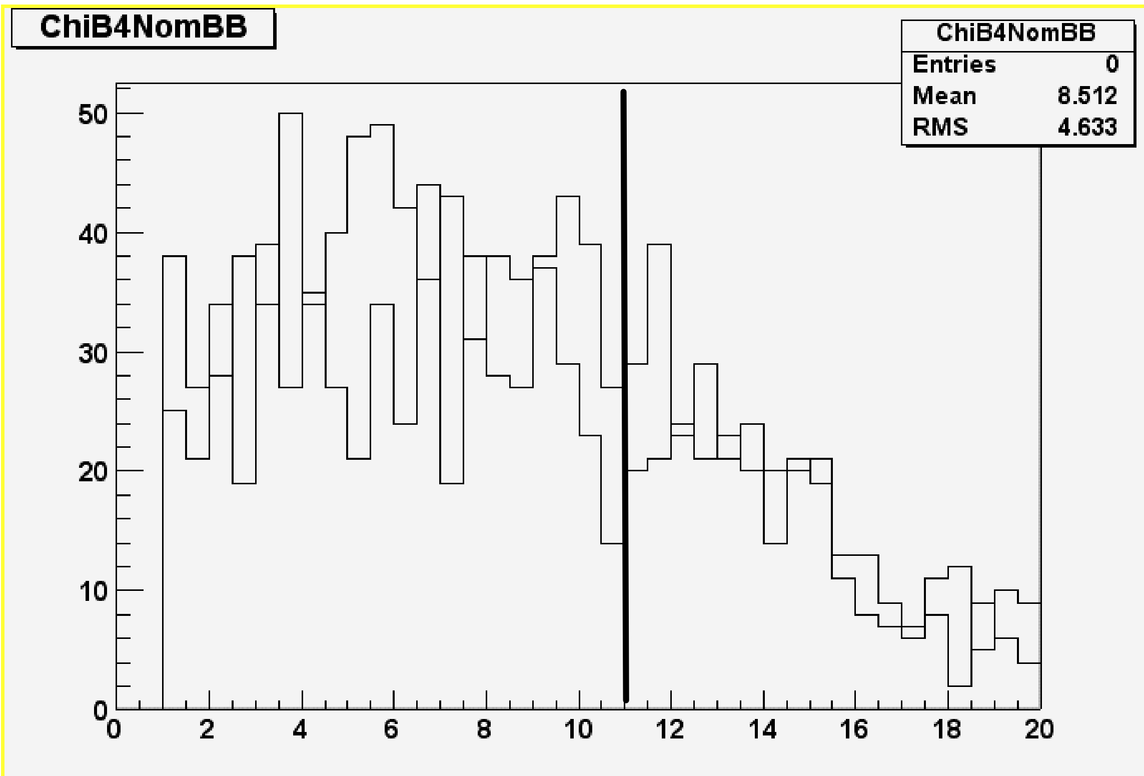
- **Results for Highest Mass bin (dijet mass > 690 GeV) for JT_95_TT trigger**



- **Data sample:**
  - **p13.06**
  - **Cal L1 |h| < 2.4**
- **No Acceptance Correction**
- **JES uncertainties**
  - **Redid analysis 1 sigma high 1 sigma low**

QCD DiJets

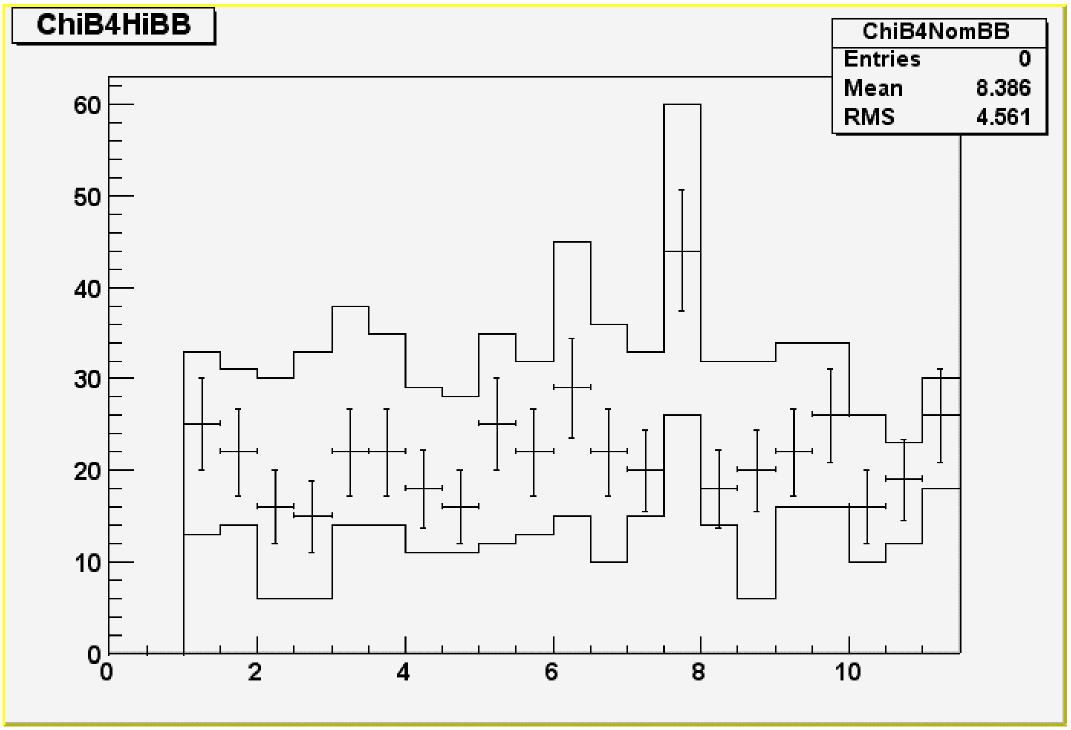
- **Results for Highest Mass bin (dijet mass > 690 GeV) for JT_95_TT trigger**



- **Data sample:**
  - **p13.06**
- **No Acceptance Correction**
- **Comparing Cal L1 Trigger**
  - **|h| < 3.2**
  - **|h| < 2.4**

QCD DiJets

- **Results for Highest Mass bin (dijet mass > 690 GeV) for JT_95_TT trigger**



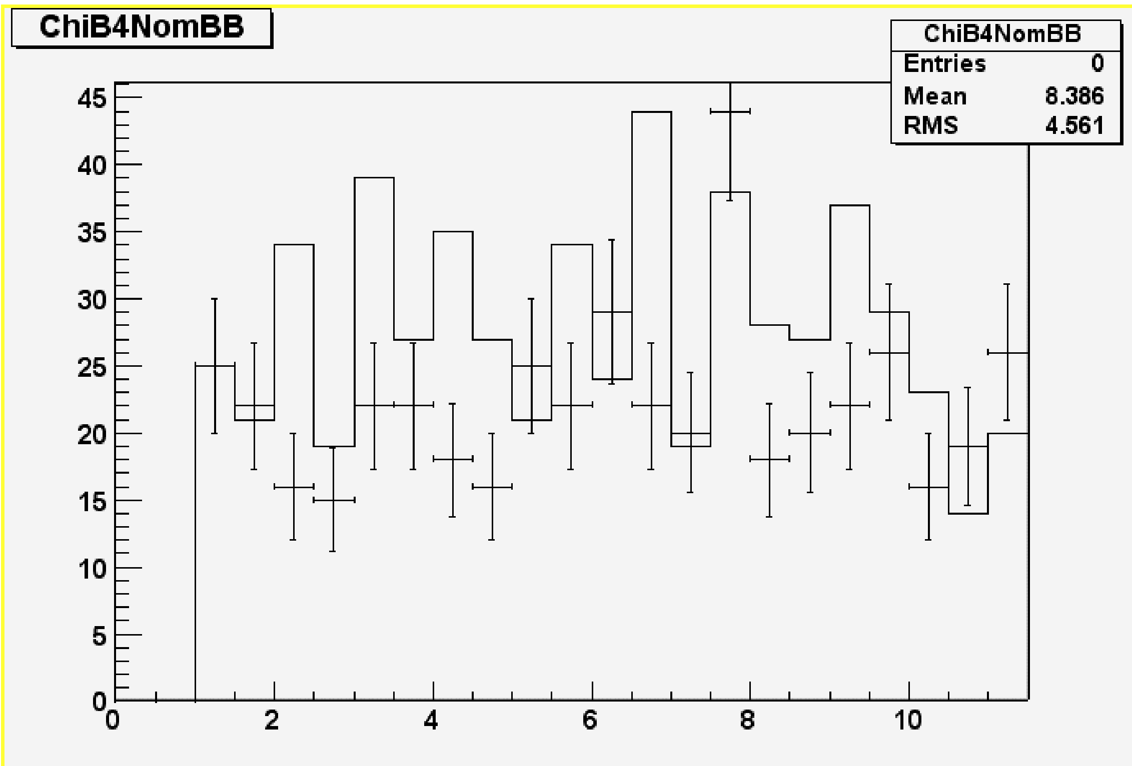
- **Data sample:**
  - **p13.05**
  - **|h| < 3.2**

- **No Acceptance Correction**

- **JES uncertainties**
  - **Redid analysis**
    1 sigma high
    1 sigma low

QCD DiJets

- **Results for Highest Mass bin (dijet mass > 690 GeV) for JT_95_TT trigger**



- **Data sample:**
  - **p13.05/p13.06**
  - **|η| < 2.4**

- **No Acceptance Correction**

- **Histo = p13.06**
- **points = p13.05**

QCD DiJets

- **Next Steps**
  - **Data**
    - **Study h bins**
      - (|η| < 0.8, 0.8 < |η| < 1.8, |η| > 1.8)
    - **Correct for jet resolutions**
      - (this is eta dependent!)
    - **Use MC resolutions for smearing**
    - **Correct data for cut acceptances**
    - **Get analysis machinery ready for p14 data**
  - **Monte Carlo**
    - **Need MC with full eta range**
    - **For compositeness scale, need to generate MC with different scale factors**